DIFF DATA INTERFACE FILE FORMAT (DIFF) USER'S MANUAL

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Appendixes are not included in the compact version.

PREFACE

Data Interface File Format, DIFF, is a computer file format to store time series data for Gait Analysis. This is proposed as a common data format to use when researchers want to exchange their gait data which are measured with different systems. It is more convenient to have one common format than to have many conversion programs depend on the other party. Because when we have one common format, we must have only two conversion programs. One of which is a conversion program from one's format to the common format, and another is a conversion program from the common format to one's format. In this way, the common format will be served as an intermediate format between each format. So we named the common format, Data Interface File Format, DIFF. We don't intend to have any standard format which restricts a development of a new system. Each system can have any format for his own.

As for DIFF there are two purposes for the clinical gait analysis. The first purpose is to construct a Data Base of the clinical gait analysis. We hope the vendors and researchers to develop at least the conversion program from their format to DIFF. And we also hope that they could send their gait data in DIFF to the Gait Library Center to accumulate many gait data. If many researchers could send us their data in DIFF, we can build a Gait Data Bank including a variety of age, sex, height, weight, way of walking and abnormalities. We will distribute the data to clinicians who need the data for their references. This process will enhance the possibility of the clinical usage of the gait measurement system very much. The information file of DIFF, which contains the information of subjects etc., will be served as the management information to retrieve gait data from the data base. We already started the service of the Gait Library Center in 1992, and over 100 gait data have been accumulated so far.

The second purpose of DIFF is to hold computer programs in common. We hope the researchers to develop computer programs to analyze gait data in DIFF, and to register the programs to the Gait Library Center to serve it as common properties. Over 20 application programs have been already registered including a stick picture animation program, an artifact modification program, a joint moment calculation program and so on. We distribute these common properties to the clinician who want to analyze DIFF gait data. This process will also help the clinician to improve the quality of life of the patients. When the library programs become sufficient, one can easily analyze DIFF gait data without having the conversion program from DIFF to one's format. Of course a person who has the conversion program from DIFF to his own format can analyze DIFF gait data with his own application programs.

DIFF is written in ASCII format, so it is independent from its operating system. It can be used in MS-DOS, WINDOWS, UNIX, and Macintosh etc. Even when new OS appears, DIFF will be able to be used in it. DIFF is a format very easy to be understood. DIFF is a format very easy to be used. It's information file can be input directly into any commercial data base systems to serve as a management information such as name of the subject, date of measurement, and name of the operator etc. Its data file can be input directly into any commercial spread sheet programs. Information file and data file can be edited and modified with any editors and/or word processors. In DIFF data file any kind of gait data can be stored. There are no limitations for the number of data. Any data of any sampling rates can be stored in DIFF data file. Even when the sampling duration and the sampling rate are different each other for each data, no problems will be happened. All data may not be started and ended at the same time. In this way DIFF is highly flexible format to store the time series data for gait analysis, motion analysis, and any kinds of analysis.

The contents of DIFF data file is device independent. Data are not expressed in output voltages etc. Instead, data are expressed in the physical values such as Newtons, degrees, meters etc. No further calculations will be required to use DIFF data. The contents of DIFF data file is Lab independent. For example, it does not depend on the force plates arrangements, nor it does not depend on the 3D camera arrangement. It does not depend on the direction of the walking. The positive direction of Y coordinate is always the direction of the subject walking. So, you don't have to know anything about the Lab setups. DIFF data is human body oriented data. XYZ coordinates of the specific points on the body in DIFF data file are not the locations of the landmarks. For example, XYZ coordinate of the hip joint may be estimated from the several landmarks around the hip joint. So, you don't have to know much about the arrangement of landmarks.

We will give you another example about the contents of DIFF data. When we say "XYZ coordinates of the hip joint", it is a kind of final target location to be calculated. However, we don't know the perfect method to measure the location of the hip joint by now. So, we have to estimate the location by some means. One may use simple way, and the other may use complicated way. As an extreme case, the location of the landmark fixed on the skin around the greater trochanter can be the first approximation of the hip joint. We don't want to enforce you to use one of the specific method. It is up to you to select the method, because it depends on your research purpose. So, it is requested to describe your method somewhere. In this way, you are requested strictly to follow the data structure of DIFF, but you are not requested strictly follow the definition of each data item. We have to discuss to find the best definition continuously. DIFF might be very useful for the discussion based on the actual gait data.

This document describes basic concept of DIFF and data arrangement such as XYZ coordinate of the specific points on

human body, floor reaction forces, body segmental angles, joint moment, location of center of gravity, and EMG etc. When you code a conversion program from your format to DIFF, you should remember that you don't have to convert all DIFF data. You only have to convert data which you want to and you can convert. For example, if you don't have joint moment calculation program, you don't have to convert joint moment data. If you have a goniometer system, you may convert only body segmental angles. When you have 3D camera system, you can calculate XYZ coordinate of the landmarks and body segmental angles, but you don't have to convert both data. Because body segmental angles are easily calculated from the landmark data on DIFF data file. So it is all up to you whether you convert both landmark data and angle data, or convert only landmark data.

DIFF was originally proposed as the common structure of the computer data file. So, one should strictly be followed to the described structure to convert and use DIFF file. DIFF structure will not be changed in a near future. However we have another concept for the contents of the DIFF data file. We think that the contents or definitions of the items should be the subject of discussion while we are using DIFF for ever. For example, there is no adequate and sufficient definition for the body segmental angles so far. Whenever better method comes up, DIFF definition should be changed. And best definition will depend on his own purpose of the measurement. In addition to that he may prefer simple definition than complicated one. So we don't want to restrict any items to only one unique definition. It might disturb the development of the new method for gait analysis.

As for the accuracy of DIFF data, our basic concept is as follows. One of the purpose to propose DIFF is to build a Data Base. We know that if the accuracy is not sufficient, we will not be able to use the Data Base. However we also know that if the requirement of the data accuracy is so high, nobody will offer his data. The main reason to build the Data Base is to

realize the value of it's existence. When many people find its usefulness, they will make every efforts to offer accurate data. So, we don't want to set any standard concerning the accuracy. Instead, we request the person who offer the data to show the check sheet of the accuracy described in Appendix. So, the user of the Data Base could refer the check sheet to find whether the accuracy of the data is good enough for his purpose.

As the last comment we will tell you about worldwide common format. We know that CAMARC project is having their standard format in EC. We don't think that DIFF and CAMARC data format oppose each other. Instead we think both can come into coexistence. We may learn from each other of their distinctive features. We will need some trial period for both to check and solve our own problems. And also we need some trial period to realize that having a common format is actuary useful to enhance the quality of life of the handicapped. After that we will be able to discuss whether we should have only one common data format in the world. Any way to have a conversion program between DIFF and CAMARC data file might be useful for the discussion. And there are no technical difficulties to do that, so it will be done in the near future.

1994. 4. 7.

CHAPTER 1　GENERAL DESCRIPTION

Introduction

This chapter gives the general structure of the common format for gait analysis. A variety of methods have been considered for how to use the standard format, but we propose the method which does not assign any limitation of each facility and each maker's format. When the necessity arises to exchange data with another facility, etc., two companies would use a common format proposed here as an intermediate. Namely, data being sent can be converted from the sender's format to the common format, whereupon the receiver can convert from the common format to his own format (herein referred to as back converting). Therefore, the common format is called as Data Interface File Format (DIFF). This format is applied to time sequential waveform data such as floor reaction force, joint angle etc., but is not applied to statistical data, such as average walking speed, stride length, and peak value of floor reaction force etc.

Form of Files

(1) Stored as text-format sequential files
(2) Alphanumerics are written in ASCII codes, however Shift JIS can be used for comments in information files (discussed later).
(3) Information files will be created separately from data files.

Overall Configuration of Files

(1) The gait data continuously taken in from the time when the START button of the data collection device is pressed until when the STOP button is pressed is called one round of gait data.

(2) For each round of walking, an information file, in which the information of the subject and the information showing the

conditions of the way of walking are written, will be created. The contents will be explained in the next paragraph.

(3) For each round of walking, at least one data file, in which that round of gait data are written, will be created. With the later-discussed single-type data file, there will be cases where more than one data file would be created for one round of walking.

(4) As mentioned above, there will be an information file and at least one data file for each round of walking. For n rounds of walking, there will be n information files and at least n data files.

Information File

(1) One information file is created for one round of walking.

(2) As to how a filename is assigned, the first six characters will be the data ID, the next two characters will be numerics assigned in sequence starting with 01 then incremented to 02, etc. to indicate the number of the trial of the current round. These numerics are named the sequential No. Therefore the filename must consist of eight characters plus the filename extension INF.
Example: TEST__01.INF

(3) In this case, the data ID is a name assigned to whole data which contains several trials of a given subject.

(4) The contents are shown on a separate sheet.

Data File

(1) For one trial of walking, at least one data file will be created. In some cases more than one data file will be created.

(2) The filename will be the same as that of the corresponding information file, but with a different filename extension. This means that the first six characters will be the data ID, the next two characters will be numerics assigned in sequence starting with 01 then incremented to 02, etc. to indicate the number of the trial of the current round of walking. The default file name extension for the data file will be DA. However, as discussed later, if the data file contains only single-type data, for example FRF data, then such a file may be given the filename extension FRF. If the data file contains some combinations of data, arbitrary filename extension, for example FGE, will be possible.
Example: D9012301.DA D9012301.FRF TEST__01.FGE

(3) In a data file, data for one trial of walking are written more than one line. Each line is named one sampling data, and each element contained in the sampling data is named data item. Characters indicating the type of data enclosed in double quote marks are to be set as the first item of each sampling data (for example, "FRF" for floor reaction force or "A1R" for joint angle, etc.) These are named data type code. The second item for each sampling data will be the time (in seconds), and for the third up to a maximum of the 32nd item, gait data will be set in fixed orders. These essential data items are specially called numerical data items. If a numerical data item is invalid, 9999.9 will be set as a invalid data item. Each sampling data

contains data items which were captured at the same time. When we say one sampling data here, it means all contents from the first character after a carriage return (CR) plus linefeed (LF) up to the next CR+LF pair. One sampling data may contain up to 32 items, delimited by commas. In cases where a sampling data does not contain data entries for all 32 items, then -9999.9 is to be set after the last item as the terminator of the sampling data. A sampling data can be terminated by -9999.9, if all items after a given item are invalid. The sampling data are to be set in time sequence starting with the earliest.

Example: "FRF",0.00, 1.2, 0.1, -0.2,-9999.9 CR+LF
"FRF",0.01, 0.2, 0.1, 40.8,-9999.9 CR+LF
"FRF",0.02, 12.7, -23.2, 69.4,-9999.9 CR+LF
"FRF",0.03, 10.2, -49.4, 113.1,-9999.9 CR+LF
"FRF",0.04, 13.4, -62.1,9999.9,-9999.9 CR+LF
etc.
etc.
etc.
etc.
"FRF",0.62, 2.3, -0.1, -1.2,-9999.9 CR+LF

Set -9999.9 at the last of each sampling data
Floor reaction force, vertical component (in newtons)
Floor reaction force, fore-and-aft component (in newtons)
Floor reaction force, right-left components (in newtons)
Time (in seconds)
Data type code to indicate that these are data for floor reaction force

CR+LF means JIS carriage return character and a JIS linefeed character.
9999.9 is an invalid data code.

(4) When there are different types of data, such as floor reaction force and joint angle, each will be put on a separate sampling data even if the time is the same, in which case the order does not matter. However, the time must be sequential overall.

Example: "FRF",0.00, ... CR+LF
"A1R",0.00, ... CR+LF
"FRF",0.01, ... CR+LF
"A1R",0.01, ... CR+LF
"FRF",0.02, ... CR+LF
"A1R",0.02, ... CR+LF

(5) The file in the above example is a compound-type with "FRF" and "A1R" data within the same file. In a compound-type file, all types of data such as "FRF" and "A1R" and any other types shown in this manual can be written within one file. On the other hand, a file contained only one type of data, for example "FRF" data in a "FRF" file, or "A1R" data in a "A1R" file, is called single-type file. Either single-type or compound-type may be used at the user's option, as long as the DIFF rules are satisfied. If the user wishes to work with the single-type files, several data files and an information file can be created for one trial of walking.

(6) As long as the sampling data are in time sequence, it does not matter if the sampling rates for floor reaction force and joint angle are different.

(7) As long as the sampling data are in time sequence, it does not matter if floor reaction force data starts and/or ends in the middle of time sequence. It does not matter if time does not start from 0.0 sec.

(8) There is no specific limit on the number of characters for each item of the sampling data as long as the entire sampling data does not exceed 240 bytes*. Numeric values must have decimal points, and exponential format is not to be used.

(9) Spaces may be added or not added, according to the user's preference, between the delimiting comma and the next item.

(10) New data types can be added at any time as necessary.

* This limitation comes from the limitation of some commercial spread sheet programs when they read a text file into their work area.

Some Points of Caution when Creating Conversion Programs

(1) All data contained should be converted to a physical value.

(2) The coordinate system is defined as subject oriented coordinate rather than space oriented coordinate which is fixed to the walking path. This means for example if the subject goes and returns the path the fore-and-aft and right-and-left coordinates will be reversed.

(3) The coordinate system for space displacement data must be the same for all measurements devices. For example, the coordinate system for point of application of floor reaction force and that for space displacement data must be the same.

(4) The origin of the coordinates for space displacement: origin for the right-and-left and the fore-and-aft axes must coincide with the origin of point of application of floor reaction force of the force plate. The surface of the floor is the origin for the vertical axis.

(5) The direction of axis of the coordinates for space displacement: for right-and-left right shall be positive, and for fore-and-aft forward positive, and for vertical upward positive.

(6) Definitions of points of articulations are given in chapter4, and details for how to attach markers to the joint and the way to estimate the point of each articulation from markers is given in Appendix A1*.

(7) Definitions of spatical angle of body segments and relative angles are given in chapter4, and details for how to calculate angles from coordinate data are given in Appendix A2.

(8) The precision registration formats for floor reaction force data as well as for 3 dimensional coordinate data are given in Appendix A3.

* Appendixes are not included in this compact version.

CHAPTER 2 ASSIGNING A FILENAME

Information file

As to how a filename is assigned, the first six characters will be the data ID, the next two characters will be numerics assigned in sequence starting with 01 then incremented to 02, etc. to indicate the number of the trial of the current round. These numerics are named the sequence No. Therefore the filename must consist of eight characters plus the filename extension INF.

IDIDID01.INF

Sequential No. to indicate the number of trial

Data ID.

Example:90123A01.INF D9412305.INF GEORGE01.FRF TEST__01.FGE

Data file

The filename will be the same as that of the corresponding information file, but with a different filename extension.

IDIDID01.DA (a case for compound-type file)
IDIDID01.FRF (a case for single-type file, if only FRF is included)

Sequential No. to indicate the number of trial

Data ID same as with an information file

For the filename extension, DA is used for a compound-type file as a rule. In case of single-type file, the extension name as same as the data type code is used as a rule. However, any other characters can be used for the extension if necessary.

Example: 90123A01.DA D9412305.DA GEORGE01.FRF TEST__01.FGE

CHAPTER 3 CONTENTS OF AN INFORMATION FILE

No.	Contents
1	Facility name, enclosed in double quote marks, within 8 characters Ex.:"TOKYO"
2	Data ID, enclosed in double quote marks, within 8 characters Ex.:"90123A" (see note 1)
3	Patient ID, enclosed in double quote marks, within 50 single-width characters (equivalent to 25 kanji characters)
4	Version number of format Ex.:"Ver.1992.06" (as with this version)
5	Comment A, enclosed in double quote marks, within 254 single-width characters (equivalent to 127 kanji characters) Overall comment common to multiple trials of walking. the first 7 bytes are to be the disability code and the next 2 are the disability side code. (see note 2)
6	Date of measurement Western date (yr) (mo) (da) Ex.:19910514
7	Subject's weight in kg. Ex.: 62.3
8	Subject's height in cm. Ex.:178.2
9	Subject's date of birth Western date (yr) (mo) (da) Ex.:19620303
10	Subject's age in years old Ex.:29.195 (see note 3)
11	Subject's gender "M" for male, "F" for female
12	Healthy or handicapped: "ABLE" for healthy "HANDI" for handicapped
13	Comment B, enclosed in double quote marks, within 254 single-width characters (equivalent to 127 kanji characters) Comment related to the current trial of walking,

for example "rapid walking"

14 Ex.:"DA_:FRF" (see note 4, _ means one space character)

15 Ex.: 201 (number of data per channel for a FRF-type data in a file with the filename extension DA)

16 Ex.:"DA_:G1R"

17 Ex.: 201 (number of data per channel for a G1R-type data in a file with the filename extension DA)

18 Ex.:"DA_:G1L"

from 14 on repeated as necessary

The above contents are to be entered delimited by commas. A CR+LF pair (hard carriage return) is not to be inserted anywhere within these contents, but is to be placed only at the end, after the last item.

Kanji characters may be used when entering items 5 and 13 above. Kanji characters may also be used when entering items 3 if necessary.

Note 1: The data ID is the filename excluding the rightmost two characters before the period and filename extension. For example, if the file name (not including the extension) is 90123A02, then 90123A would be the data ID.

Note 2: The first 7 characters of comment A must be the Disability Code. The disability Code represents the classification of the dysfunction according to the Functional Independence Measure (FIM). For subjects with multiple disability, the disability code which is the main cause of walking dysfunction should be written.

Disability Code

01.000 Cerebral apoplexy
- 01.1000 Left side paralyzed (right brain disability)
- 01.2000 Right side paralyzed (left brain disability)
- 01.3000 Both sides paralyzed
- 01.4000 No paralysis
- 01.9000 Miscellaneous cerebral apoplexy

02.000 Brain dysfunction
- 02.1000 Internal brain damage
- 02.2000 Traumatic brain damage
  - 02.2100 Disconnection
  - 02.2200 Nondisconnection
- 02.9000 Miscellaneous brain dysfunction

03.0000 Neural disorders
- 03.1000 Multiple sclerosis
- 03.2000 Parkinson's disease
- 03.3000 Multiple neuritis
- 03.4000 Guillain-Barre syndrome
- 03.9000 Miscellaneous neural disorders

04.0000 Spinal dysfunctions
- 04.1000 Internal damage
  - 04.1100 Paraplegia
  - 04.1110 Partial paraplegia
  - 04.1120 Full paraplegia
  - 04.1200 Quadriplegia
  - 04.1211 Partial quadriplegia C1-C4
  - 04.1212 Partial quadriplegia C5-C8
  - 04.1221 Full quadriplegia C1-C4
  - 04.1222 Full quadriplegia C5-C8
  - 04.1300 Miscellaneous spinal dysfunctions from internal damage
- 04.2000 Traumatic damage
  - 04.2100 Paraplegia
  - 04.2110 Partial paraplegia
  - 04.2120 Full paraplegia

04.2200 Quadriplegia
04.2211 Partial quadriplegia C1-C4
04.2212 Partial quadriplegia C5-C8
04.2221 Full quadriplegia C1-C4
04.2222 Full quadriplegia C5-C8
04.2300 Miscellaneous spinal dysfunctions from external damage

05.0000 Amputation
05.1000 Unilateral amputation above the elbow (AE)
05.2000 Unilateral amputation below the elbow (BE)
05.3000 Unilateral amputation above the knee (AK)
05.4000 Unilateral amputation below the knee (BK)
05.5000 Bilateral amputation both above the knee (AK/AK)
05.6000 Bilateral amputation one above, one below (AK/BK)
05.7000 Bilateral amputation both below the knee (BK/BK)
05.9000 Miscellaneous combination

06.0000 Arthritis
06.1000 Rheumatism
06.2000 Osteoarthritis
06.3000 Miscellaneous

07.0000 Pain
07.1000 Neck pain
07.2000 Back pain
07.3000 Pain in extremities
07.9000 Miscellaneous pain

08.0000 Orthopedic
08.1000 After fracture of the hip joint
08.2000 After fracture of the femur (shaft)
08.3000 After pelvic fracture
08.4000 Multiple fracture of major joint
08.5000 After total hip replacement
08.6000 After total knee replacement

08.9000 Miscellaneous orthopedic

09.0000 Heart disease

10.0000 Lung ailments
10.1000 Chronic obstructive lung disease
10.9000 Miscellaneous lung disorder

11.0000 Burns

12.0000 Congenital defects
12.1000 Double spine
12.9000 Miscellaneous congenital defects

13.0000 Miscellaneous dysfunction-causing maladies

The next 2 bytes after the disability code are the disability side code.
01 Right side affected
02 Left side affected
03 Both sides affected

Note 3: The subject's age is indicated by the quotient of the number of days difference between the year, month and day of measurement and the year, month and day of the subject's date of birth divided by 365.25, rounded to three decimal places. When it is not necessary to show this so strictly, the age can be converted to an integer for the actual number of years, for example, 36.0 for someone 36 years old.

Note 4: For item 14 and on, first write the filename extension of the data file and data type code such as "DA_:FRF" and then after the delimiting comma, write the number of data per channel for that data, not in binary, but in ASCII. For example, for

data at a frequency of 50 Hz from 0.00 second to 4.00 seconds, this number would be 201. The order of the data type is the user's option. Also, data types not measured does not need to be written.

Example of items from 14 on :

..... "DA_:FRF",201,"DA_:G1R",201,"FRF:FRF",201,.....

Data file with the extension DA, FRF and G1R would have 201 data per channel. Also, this means that data file with the extension FRF, FRF would have 201 data as well.

Sample of Information File

Facility name	Data ID	Patient ID	Version No.
"Tokyo",	"90123A",	"X32819A",	"Ver.1992.06",

Comment A	Date of measurement	Patient's weight in kg.	Patient's height in cm.
"05.30001...",	19910514,	64.5,	178.20,

Patient's (yr)(mo)(da) of birth	patient's age	Patient's gender
19620303,	29.195,	"M",

Healthy or handicapped	Comment B	Type	No. of data
"HANDI",	"Readily...",	"DA_:FRF",	201

Type	No. of data	Type	No. of data	
"DA_:G1R",	201,	"DA_:G1l",	201	CR+LF

_ means one space character.

One Sampling Data of Floor Reaction Force Data

No.	Contents	Unit
1	Data type "FRF"	
2	Time	seconds
3	FRF LR component R foot (right +)	newtons(N)
4	" FWD component " (forward +)	"
5	" VERT component " (reaction force +)	"
6	" LR component L foot (right +)	"
7	" FWD component " (forward +)	"
8	" VERT component " (reaction force +)	"
9	" LR component LR cmb.(right +)	"
10	" FWD component " (forward +)	"
11	" VERT component " (reaction force +)	"
12	FRF point of application LR R foot (right +)	m
13	" FWD " (forward +)	"
14	" LR L foot (right +)	"
15	" FWD " (forward +)	"
16	" LR LR cmb. (right +)	"
17	" FWD " (forward +)	"
18	Torque around vert.axis for point of appl. R foot (opposing torque counterclockwise as viewed form above)	Nm
19	" L foot (")	"
20	" LR cmb.(")	"
21	-9999.9 (see note)	

The above contents are to be entered delimited by commas. A CR+LF pair (hard carriage return) is not to be inserted anywhere within these contents, but is to be placed only at the end, after the last item.

Note: If there is no further information to be entered beyond these items, enter -9999.9 at 21st item and then a hard carriage return (CR+LF).

One Sampling data of Space Displacement Data (for Right Limb)

No.	Contents			Unit
1	Data type	"G1R"		
2	Time			seconds
3	Top of head		LR (right +)	m
4	"		FWD (forward +)	"
5	"		VERT (upward +)	"
6	R side	Acromion	LR	"
7	"	"	FWD	"
8	"	"	VERT	"
9	"	Hip joint	LR	"
10	"	"	FWD	"
11	"	"	VERT	"
12	"	Knee joint	LR	"
13	"	"	FWD	"
14	"	"	VERT	"
15	"	Ankle joint	LR	"
16	"	"	FWD	"
17	"	"	VERT	"
18	"	Metatarsus	LR	"
19	"	"	FWD	"
20	"	"	VERT	"
21	"	Heel	LR	"
22	"	"	FWD	"
23	"	"	VERT	"
24	"	Toe	LR	"
25	"	"	FWD	"
26	"	"	VERT	"
27	"	Ilium	LR	"
28	"	"	FWD	"
29	"	"	VERT	"
30	-9999.9			

Hip joint: geometric center of the acetabulum
Knee joint: fore-and-aft and mediolateral center of the femur at the height of maximum fore-and-aft diameter of distal end of the femur in standing position
Ankle joint: center point of the line connected medial and lateral malleolus
Metatarsus: center point of the line connected medial #1 metatarsal and lateral #5 metatarsal
Toe: most forward part of the foot

The above contents are to be entered delimited by commas. A CR+LF pair (hard carriage return) is not to be inserted anywhere within these contents, but is to be placed only at the end, after the last item.

Note: Even if the forward direction of walking changes during measurement, the coordinate system for the time of start of measurement does not change.
Note: Origin for the vertical axis is the surface of the floor. The origin of fore-and-aft and right-and-left axes must coincide with the origin of the point of force application in FRF, if force plate data was measured simultaneously. In case of the measurement without force plate, the origin depends on user's preference.

One Sampling data of Space Displacement Data (for Left Limb)

No.	Contents			Unit
1	Data type	"G1L"		
2	Time			seconds
3	Top of head		LR (right +)	m
4	"		FWD (forward +)	"
5	"		VERT (upward +)	"
6	L side	Acromion	LR	"
7	"	"	FWD	"
8	"	"	VERT	"
9	"	Hip joint	LR	"
10	"	"	FWD	"
11	"	"	VERT	"
12	"	Knee joint	LR	"
13	"	"	FWD	"
14	"	"	VERT	"
15	"	Ankle joint	LR	"
16	"	"	FWD	"
17	"	"	VERT	"
18	"	Metatarsus	LR	"
19	"	"	FWD	"
20	"	"	VERT	"
21	"	Heel	LR	"
22	"	"	FWD	"
23	"	"	VERT	"
24	"	Toe	LR	"
25	"	"	FWD	"
26	"	"	VERT	"
27	"	Ilium	LR	"
28	"	"	FWD	"
29	"	"	VERT	"
30	-9999.9			

Hip joint: geometric center of the acetabulum
Knee joint: fore-and-aft and mediolateral center of the femur at the height of maximum fore-and-aft diameter of distal end of the femur in standing position
Ankle joint: center point of the line connected medial and lateral malleolus
Metatarsus: center point of the line connected medial #1 metatarsal and lateral #5 metatarsal
Toe: most forward part of the foot

The above contents are to be entered delimited by commas. A CR+LF pair (hard carriage return) is not to be inserted anywhere within these contents, but is to be placed only at the end, after the last item.

Note: Even if the forward direction of walking changes during measurement, the coordinate system for the time of start of measurement does not change.
Note: Origin for the vertical axis is the surface of the floor. The origin of fore-and-aft and right-and-left axes must coincide with the origin of the point of force application in FRF, if force plate data was measured simultaneously. In case of the measurement without force plate, the origin depends on user's preference.

One Sampling data of Space Displacement Data (#2 for Right Limb)

No.	Contents			Unit
1	Data type	"G2R"		
2	Time			seconds
3	Top of head		LR (right +)	m
4	"		FWD (forward +)	"
5	"		VERT (upward +)	"
6	R side	Tragus	LR	"
7	"	"	FWD	"
8	"	"	VERT	"
9	"	Acromion	LR	"
10	"	"	FWD	"
11	"	"	VERT	"
12	"	Shoulder joint	LR	"
13	"	"	FWD	"
14	"	"	VERT	"
15	"	Elbow joint	LR	"
16	"	"	FWD	"
17	"	"	VERT	"
18	"	Wrist joint	LR	"
19	"	"	FWD	"
20	"	"	VERT	"
21	"	Fingertips	LR	"
22	"	"	FWD	"
23	"	"	VERT	"
24	-9999.9			

The above contents are to be entered delimited by commas. A CR+LF pair (hard carriage return) is not to be inserted anywhere within these contents, but is to be placed only at the end, after the last item.

Note: Even if the forward direction of walking changes during measurement, the coordinate system for the time of start of

measurement does not change.

Note: Origin for the vertical axis is the surface of the floor. The origin of fore-and-aft and right-and-left axes must coincide with the origin of the point of force application in FRF, if force plate data was measured simultaneously. In case of the measurement without force plate, the origin depends on user's preference.

One Sampling data of Space Displacement Data (#2 for Left Limb)

No.	Contents			Unit
1	Data type	"G2L"		
2	Time			seconds
3	Top of head		LR (right +)	m
4	"		FWD (forward +)	"
5	"		VERT (upward +)	"
6	L side	Tragus	LR	"
7	"	"	FWD	"
8	"	"	VERT	"
9	"	Acromion	LR	"
10	"	"	FWD	"
11	"	"	VERT	"
12	"	Shoulder joint	LR	"
13	"	"	FWD	"
14	"	"	VERT	"
15	"	Elbow joint	LR	"
16	"	"	FWD	"
17	"	"	VERT	"
18	"	Wrist joint	LR	"
19	"	"	FWD	"
20	"	"	VERT	"
21	"	Fingertips	LR	"
22	"	"	FWD	"
23	"	"	VERT	"
24	-9999.9			

The above contents are to be entered delimited by commas. A CR+LF pair (hard carriage return) is not to be inserted anywhere within these contents, but is to be placed only at the end, after the last item.

Note: Even if the forward direction of walking changes during measurement, the coordinate system for the time of start of

measurement does not change.

Note: Origin for the vertical axis is the surface of the floor. The origin of fore-and-aft and right-and-left axes must coincide with the origin of the point of force application in FRF, if force plate data was measured simultaneously. In case of the measurement without force plate, the origin depends on user's preference.

One Sampling Data of Spatial Angle for Body Segment

No.	Contents		Unit
1	Data type	"S1B"	
2	Time		seconds
3	Head	Fore-and-aft leaning angle (back +)	degrees
4	"	LR bending angle (left +)	"
5	"	LR rotation angle (left +)	"
6	Abdomen	same as above	"
7	"	"	"
8	"	"	"
9	Pelvis	"	"
10	"	"	"
11	"	"	"
12	-9999.9		

The above contents are to be entered delimited by commas. A CR+LF pair (hard carriage return) is not to be inserted anywhere within these contents, but is to be placed only at the end of the line, after the last item.

The spatial angle of a body segment is the relative angle formed between the coordinate system for the walking path and the coordinate system for the body segment. The coordinate system for the walking path is fixed coordinate system for the waling path, and the coordinate systems for the body segment are fixed-coordinate systems for each respective body segment.

The spatial angle is defined for the right limb coordinate a) the angle from the vertical axis as viewed from the right-hand plane in sagittal plane, b) the angle from the horizontal axis as viewed from the rear in transverse plane, c) the angle from the forward axis as viewed from above, with counterclockwise as positive.

For the left limbs, a) the angle from the vertical axis as viewed from the left-hand plane in sagittal plane, b) the angle from the horizontal axis as viewed from the rear in transverse plane, c) the angle from the forward axis as viewed from above, with clockwise as positive.

For convenience, the coordinate system for the left limb is also to be used for the trunk.